BARRIERS INCREASE EFFICIENCY OF PITFALL TRAPS[2,3]

Thomas J. Durkis[4], R. Marcel Reeves[5]

ABSTRACT: The efficiency of a newly designed barrier-pitfall trap was investigated. The trap is inexpensive and easily constructed and consists of two plastic collecting containers buried at ground level and connected by a clear plastic barrier. Addition of a barrier increased numbers of surface dwelling arthopods caught compared to traps without barriers. Nearly two times as many ground beetles and other insects were caught with each two foot increment in barrier length. The trap is suitable for collecting live specimens or may be used with killing - preserving agents.

Ground beetles (Family Carabidae) are primarily nocturnal, carnivorous insects that live on or near the ground. Their secretive habits make daytime searching and collecting activities tedious and inefficient. Of the various trapping devices available, pitfall traps are most commonly used and are superior to all other methods (Thiele 1977).

The effectiveness of pitfall traps as qualitative sampling tools have been shown by Orbtel (1971) who found that increased numbers of pitfall traps resulted in an increased number of species caught. Pitfall traps have also been useful for gathering life history and distributional information (Mitchell 1963, Rivard 1964, Leech 1966, Barlow 1970, Goulet 1974 and Larochelle 1975). Thiele (1977) summarized pitfall trap investigations in central Europe and concluded that only active carabids are likely to be caught; Thomas and Sleeper (1977) came to the same conclusion for the family Tenebrionidae.

Both Mitchell (1963) and Greenslade (1964) found pitfall traps of little value as quantitative sampling devices for either estimating populations or making community comparisons. Greenslade (1964) even concluded that pitfall trapping could not be used for quantitatively assessing the carabid beetle fauna of any habitat. Southwood (1966) expanded on Greenslade's criticisms of pitfall trapping of carabid beetles by including all other animals as well. However, Banerjee (1970), working with millipedes, found that the number trapped could be used to estimate population densities. Uetz and Unzicker (1976) working with wandering spiders compared pitfall traps to

[1]Received November 8, 1980

[2]From a thesis submitted by the first author as partial fulfillment for the requirements of the Master of Science Degree, 1975.

[3]Scientific Contribution Number *1063* from the New Hampshire Agricultural Experiment Station.

[4]New Hampshire Department of Agriculture, Nesmith Hall, Durham, New Hampshire 03824.

[5]Department of Entomology, Univesity of New Hampshire, Durham, New Hampshire, 03824.

ENT. NEWS, 93 (1) 25-28, January & February, 1982

quadrat sampling and found pitfall traps more useful in species diversity studies. They proposed several conditions for limiting the use of pitfall trapping in ecological research.

Various investigators have designed or modified pitfall traps for their own specific needs. Fichter (1941) designed an elaborate pitfall trap to help eliminate rain water. Williams (1958), Houston (1971), and Holthaus and Riechert (1973) all experimented with various timing and mechanical sorting devices. Wojcik et al. (1972) and Morrill (1975) concentrated their efforts on developing quick and inexpensive plastic pitfall traps. Cutler, et al. (1975) and Uetz and Unzicker (1976) found aprons increased the catch of spiders in pitfalls and Housewart, et al. (1979) adapted the apron to a large capacity pitfall trap. Thiele (1977) discussed several preservatives and attractants that can be used with pitfall traps, while Thomas and Sleeper (1977) note several precautions which may help to avoid non-random effects. Trap modifications which attempt to direct or guide organisms to the pitfall trap were studied by Smith (1976) who used several "drift fence" designs around single gallon sized cans. He increased beetle catches up to 3.2 times for certain designs. The "barrier-pitfall" trap (Reeves 1980) used in this study is similar to Smith's but has pitfalls at each end of a "barrier" rather than a single pitfall at the center of a "drift fence".

Traps used in this study were developed after several years of experimentation and improvement (Reeves 1980). The barrier-pitfall traps consisted of 2 pitfalls connected by varying lengths of 6 inch (15 cm) high plexiglass®. Tested lengths were 1 foot (30.5cm), 3 feet (91.5cm) and 5 feet (152.5cm). Each pitfall consisted of 3 plastic cups (Reeves 1980). The larger outer cup had small holes in the bottom for rainwater drainage.

This experiment was conducted in a mixed hardwood stand located in Stafford County, Lee, New Hampshire. Northern red oak, *Quercus rubra* L., red maple, *Acer rubrum* L., sugar maple, *Acer saccharum* Marsh. and shagbark hickory, *Carya ovata* (Mill.) K. Koch comprised most hardwood species present. Small amounts of eastern white pine, *Pinus strobus* L. and eastern hemlock, *Tsuga canadensis* (L.) Carr. were scattered through the hardwood mixture. The area was bordered on three sides by fields, one planted to corn.

Ten rows with 6 barrier-pitfall traps each were established in the spring of 1974; five rows on April 30 and the remainder in early June. Rows were approximately 50 feet (15 m) apart with traps in each row spaced about 25 feet (7.5 m) apart. Local ground conditions (roots, rocks, etc.) did not permit precise distances between all trap units or the alignment of all barriers in the same direction. Each row contained 6 different trap designs; 2 traps with the cups 1 foot apart; 2 traps with the cups 3 feet apart; and 2 traps with the cups 5 feet apart. One trap of each spacing was supplied with a barrier, while the other was without a barrier. Locations within a row were chosen randomly.

Traps were emptied twice a week on Tuesday and Thursday from 2

May through 13 August 1974. Contents of the traps were recorded in the field and their live animals released within 10 feet (3.3 m) of the trap in which they were caught. To minimize bias due to trap location, traps with and without barriers were rotated within the same spacing length in each row following the July 9 collections. A total of 30 collections were made, 20 in period one (2 May through 9 July) and 10 in period two (11 July through 13 August) (Fig. 1). Increased trap disturbance by raccoons in early August caused discontinuation of the study after 13 August. Where one or more traps were disturbed in a row the data from that row were discarded.

Traps with and without barriers caught about the same number (201 viz. 193) of ground beetles during the first period at the 1 foot spacing. However, during period two, traps with barriers caught 1.8 times as many beetles as traps without barriers (Fig. 1). Traps with a 3 foot spacing caught 2.0 and 2.5 times as many beetles during periods one and two respectively

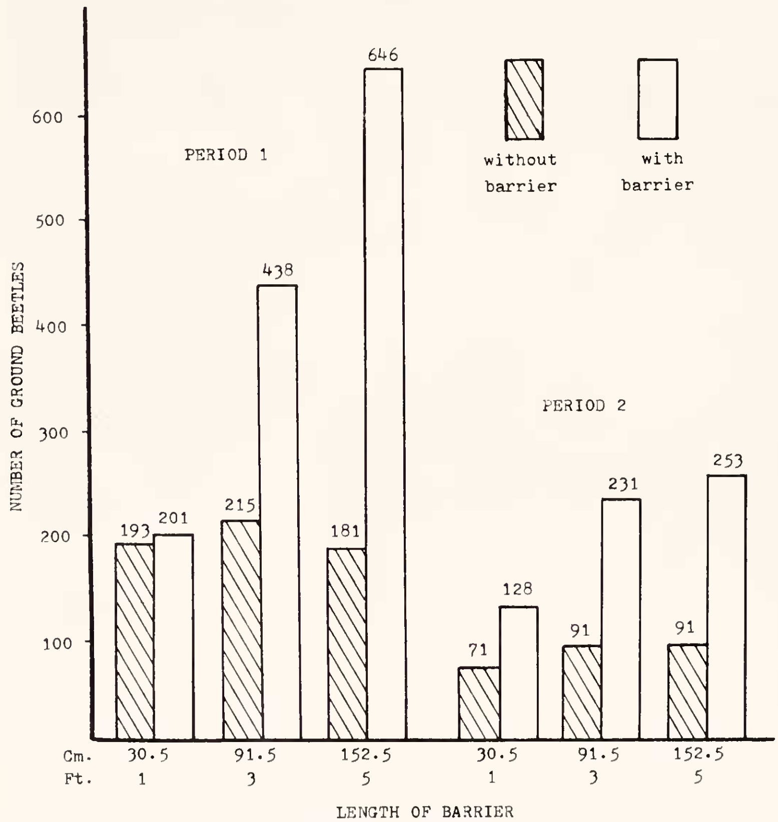

Figure 1. Number of adult carabid beetles caught in traps with and without barriers for period 1 (2 May through 9 July) and period 2 (11 July throrugh 13 August).

as traps without barriers. At the 5 foot spacings, these ratios increased to 3.6 for period one and 2.8 for period two.

Comparison of catches within each period shows that traps without barriers caught nearly the same number of beetles regardless of the distance between the pitfalls. As barrier length increased, traps with barriers caught more beetles. Thus, 3 foot barrier traps caught 2.2 times as many carabids as 1 foot long barrier traps. Five foot barrier traps caught 1.5 times as many beetles as 3 foot barrier traps and 3.2 times as many as traps with 1 foot barriers. These same comparisons for period 2 are 1.8, 1.1 and 2.0 respectively.

The strength of association determined by Chi-Square (X^2) was 91.97 for period one ($P \leq 0.001$) and 8.85 for period two ($P \leq 0.100$). The reduced significance for period two is probably the result of only half as many observations due to predator disturbance. Rotation of the barriers is not considered a factor. Although reduced observations may have affected statistical significance, percentages of total beetles caught in traps with barriers remained nearly the same: 69% for period one and 71% for period two.

Our results compare favorably with those of Smith (1976), although features differed, such as duration of the trapping period, number of pitfalls/trap, length and numbers of barriers and trap orientation. Smith's cross trap caught 11.3 times as many insects as an unfenced trap and approximately 4 times as much as a single V-shaped trap. We conclude that the addition of a fence or barrier significantly increases the catch of ground-dwelling insects.

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